Obliteration of the Disrupted Portion of the Internal Carotid Artery Using Guglielmi Detachable Coils in a Patient with a Traumatic Aneurysm of the C2 and C3 Segments

H. KAWAMOTO, T. INAGAWA, F. IKAWA, N. OHBAYASHI, S. SAKAMOTO

Departments of Neurosurgery, Shimane Prefectural Central Hospital, Izumo; Japan

Key words: traumatic aneurysm, internal carotid artery, C2-3, GDC

Introduction

Intracranial traumatic aneurysms following nonpenetrating head trauma are classified into two groups: those at the skull base and those in peripheral regions [1].

The former lesions more commonly involve the internal carotid artery (ICA) than the basilar or vertebral artery [1]. The latter lesions include aneurysms of the distal anterior cerebral artery caused by injury from the falx (perifalcine type), and those of cortical arteries associated with linear fractures of the skull vault, mainly in the territory of the middle cerebral artery [1,2].

Traumatic aneurysms of the intracranial segment of the ICA occurred in 2.6% of patients with sphenoid fractures [3].

Traumatic aneurysms of the infraclinoid (C3) segment of the ICA are treated by exclusion from the circulation, using surgical trapping or proximal occlusion of the ICA; those of the supraclinoid (C2) segment of the ICA are trapped, clipped, or wrapped [1,4-7]. We encountered a patient with a traumatic aneurysm involving both the supraclinoid (C2) and infraclinoid (C3) segments of the ICA. We describe events in this case, and discuss treatment for such aneurysms.

Case Reports

A 26-year-old man involved in a motor vehicle accident had a Glasgow Coma Scale score of 6 on admission. Computed tomogram (CT) showed large epidural and subdural hematomas bilaterally in the frontal region and in the left temporoparietal region; subarachnoid hemorrhage was present in the basal cistern. CT using bone windows showed fractures of the sphenoid body and temporal bone (LeFort type III) predominantly involving the left side (figure 1). The patient underwent evacuation of hematomas and external decompression. Blindness and total ophthalmoplegia were noticed in the left eye after recovery of consciousness. We performed a cranioplasty and placed a shunt to treat hydrocephalus on hospital day 51. Four hours after surgery, sudden, voluminous epistaxis occurred accompanied by shock. Cerebral angiography showed a traumatic aneurysm involving both the supraclinoid (C2) and infraclinoid (C3) segments of the left ICA (figure 2). The aneurysm showed areas of irregular bulging. We performed a test occlusion of the left cervical ICA using a balloon. No new neurologic symptoms appeared for 30 min during this temporary occlusion. Single-photon

Figure 1 In computed tomography performed on admission, bone windows show fractures of the sphenoid body and temporal bones. Damage to the skull base is more severe on the left side than on the right.

emission CT show no hypoperfusion in the territory of the left ICA. The stump and systemic mean blood pressures measured 78 and 90 mm Hg respectively (ratio, 87%). Good collateral flow through the circle of Willis was visualized angiographically. However, left vertebral arteriography during the test occlusion showed filling of the dome of the ICA aneurysm. After detailed delineation of the aneurysm by aneurysmography, we performed obliteration of the disrupted part of the left ICA using Guglielmi detachable coils (GDCs) (Boston Scientific, MA) (figure 2). In the early stage of this procedure, we controlled proximal blood flow using the balloon to prevent strong flow in the ICA from causing distal migration of GDCs and thrombus into the intracranial circulation. To prevent retrograde filling of the aneurysm, we used a firm, long GDC (18; 6 mm x 20 cm) to obliterate the C2 segment of the ICA including the small areas of bulging. Next we consecutively occluded the aneurysm dome, which protruded into the sphenoid sinus. Then, using a second GDC (18; 8 mm x 30 cm), we occluded the disrupted C3 segment of the ICA. Finally, we obliterated the ICA from the C4 segment to the uppermost cervical segment using several GDC 18s and 10s. After the procedure, ischemic events did not occur and epistaxis was arrested. Obliteration of both the aneurysm and the left ICA was confirmed by angiography at three and six months after treatment.

Discussion

In patients with traumatic aneurysms involving the infraclinoid (C3) segment of the ICA, either proximal occlusion or surgical trapping has been recommended, because of fragility of the wall of the aneurysm[1,4-7].

However, in patients with sufficient collateral circulation, proximal occlusion alone can be insufficient[2,4,6,8], requiring an invasive procedure such as surgical trapping rather than proximal occlusion[9]. Recently, Uzan et al produced an occlusion just proximal to the disrupted ICA segment by an endovascular procedure[9]. These authors stressed an important advantage of endovascular procedures: test occlusion with a balloon can be used to predict the ability to tolerate permanent endovascular occlusion of the ICA[10-13]. On the other hand, in a portion of patients with traumatic aneurysms located in the cavernous sinus, the aneurysm can be obliterated by endovascular procedures without occlusion of the parent artery[14,15].

Our patient had a traumatic aneurysm of the C2 and C3 segments of the ICA, and proximal occlusion or trapping of the ICA ordinarily might have been indicated. However, the results of balloon test occlusion of the ICA suggested that if only proximal occlusion were performed, a danger of bleeding from the remnant of the aneurysm existed. Specifically, a vertebral arteriogram showed filling of the dome of the aneurysm during test occlusion of the ICA. Therefore, we occluded the ICA not from the proximal portion to but from the lesion including the disrupted portion. We considered this procedure preferable for two reasons. First, while an endovascular procedure and surgical trapping could both prevent rupture of the aneurysm, the former procedure would be less invasive and provides easier access than surgical trapping. Second, in comparison with proximal occlusion either by an endovascular proce-

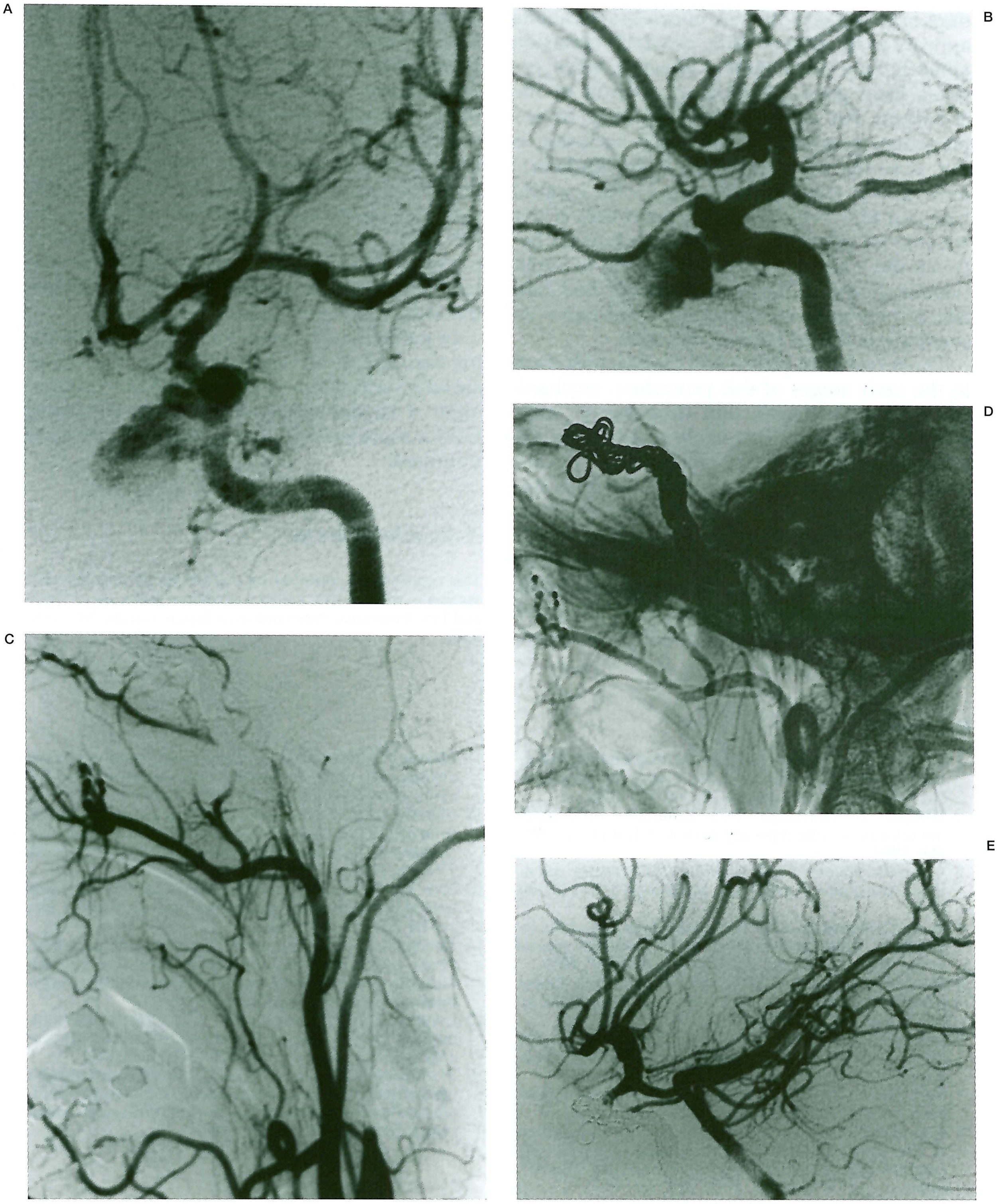

Figure 2 Angiographic findings. A, B) Anteroposterior and lateral views of the initial angiogram showing the left internal carotid artery (ICA). A traumatic aneurysm of the infraclinoid segment of the ICA is shown to project into the sphenoid sinus. The aneurysm shows irregular bulges. C-E) were obtained after obstruction of ICA using the Guglielmi detachable coils. C,D) Lateral views of the left common carotid arteriogram with and without subtraction. Coils were placed to obliterate the disrupted part of the ICA including the bulges from the aneurysm. E) Lateral view of the left vertebral arteriogram. Despite excellent collateral flow, no filling of the aneurysm is shown.

dure or by surgery, the risk of cerebral ischemia appears to be similar, while proximal occlusion alone is only incompletely effective when patients have good collateral circulation to the aneurysm. An important disadvantage of our procedure compared to proximal occlusion is that ischemic injury can occur to the ipsilateral optic nerve; this can also occur with surgical trapping. However, blindness occurs only rarely because of abundant collateral circulation between the external carotid artery and the ophthalmic artery [16]. Our patient already had ipsilateral blindness, so iatrogenic optic nerve ischemia was not an issue in this case.

Three technical points concerning coils were in the early stages of this procedure: mechanical properties, length, and diameter of coils. First, GDC18s are more likely to perforate the aneurysm than GDC10s, because GDC18s are more rigid. However, we used GDC18s because we considered them to be more stable in resisting the hyperdynamic blood flow in the ICA. Second, we used long GDC18s (20 and 30 cm) because we thought that long coils would be more stable than short ones (10 cm) because of greater friction against the wall of the vessel. Third, we used GDC18s that had a slightly larger in diameter (6 and 8 mm) than the ICA (approximately 5 mm). Coils with diameters exceeding that of the ICA carry an increased risk of perforation, considering the fragility of the aneurysm; however, thinner coils are likely to migrate into the distal ICA. Using coils slightly larger diameter than that of the ICA, permitted safe obliteration of the affected portion of the left ICA. Finally, we stress the importance of proximal flow control using the balloon to prevent distal migration of coils and thrombus into the intracranial circulation.

In patients with traumatic aneurysms involving the C2 and C3 segments of the ICA, in association with abundant collateral flow, obliteration of the disrupted portion of the ICA using GDCs represents effective, minimally invasive treatment.

Acknowledgements

This report was supported by a grant for clinical research associate with motor vehicle accidents from the Marine and Fire Insurance Association of Japan. (Grant No. 2000-110).

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Hitoshi Kawamoto, M.D.
Department of Neurosurgery,
Shimane Prefectural Central Hospital,
Himebara-cho, Izumo, Shimane, 693-8555, Japan
E-mail: kawamoto@mail.spch.izumo.shimane.jp